Ohio Wesleyan University

PATRICIA BELT CONRADES
Summer Science Research Symposium

SEPTEMBER 19, 2011

JESSICA BRENNEMAN FETTERMAN

OWU 2007, UNIVERSITY OF ALABAMA PH.D. 2011

> “It was through my summer research experience at OWU that I realized I wanted to continue doing research and go on to a biomedical graduate program. Reading about research and getting to do it firsthand really opened my eyes to all the career options available to a scientist, and I found I had a real passion for working in a lab.”

THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM

Science, mathematics, and technology continue to increase in importance as the world becomes smaller and more interdependent. Through ongoing research, scientists can help solve global problems—from eradicating infectious diseases to discovering new sources of clean, safe energy.

Now it its nineteenth year at Ohio Wesleyan, the Summer Science Research Program, which culminates in today's Patricia Belt Conrades Summer Science Research Symposium, encourages students to tackle tough research issues by offering an intensive 10-week opportunity to work with seasoned, accomplished mentors both on and off campus. The posters you see here today depict the research results. Please ask the students any questions you wish; they are proud and happy to tell you what they learned and why it matters.

Contents

Atrium, Schimmel/Conrades Science Center

Monday, September 19, 2011, at noon

Opening remarks by President Rock Jones followed by student poster presentations

Thoughts from the Director

Ohio Wesleyan University encourages students to take the theory learned in the classroom and put it into practice in the real word.

While many new curricular initiatives are providing these opportunities for all OWU students, the Summer Science Research Program (SSRP) has been modeling this concept for almost two decades.

In this rich and varied program, students spend 10 weeks in the summer working side by side with faculty mentors on research projects that are connected to the students' particular scientific interests. At larger institutions, undergraduate students join an existing research group consisting of graduate students and post-doctoral fellows. At Ohio Wesleyan, that's not the case. Here, students are the central researchers in their projects. They participate in all the steps of the research process, taking ownership of the successes, the failures, and the knowledge gained. Throughout this process, they grow into mature, self-directed, confident investigators who add their own pieces of knowledge to the greater body of scientific understanding.

Today, the students participate in another very important part of scientific work: explaining their research posters to scientists and nonscientists alike. As you talk with the students, you will appreciate the depth of their understanding. They can explain their work because they understand the fundamentals of the project and have recognized and pondered its nuances.

It's probable that many of these students will present again at major meetings of national scientific societies, interacting the most prominent scientists in their fields of interest and making the connections that will help them as they further their work in graduate school or in an immediate scientific career. Today may mark the first step in a long lifetime of professional achievement.

We are grateful to Dr. Nancy Schneider '64 for providing the endowed funds that make this celebration of scholarship a reality each year.

In the following pages, you'll meet Ohio Wesleyan students who conducted research both on and off the campus, as well as students from other colleges who carried out research on our campus under a National Science Foundation Research Experiences for Undergraduates (REU) Grant awarded to our faculty in physics, astronomy, computer science, and mathematics.

Congratulations to all who participated in this exceptional research program.

Barbara Andereck
Summer Science Research Program Director
Associate Dean for Academic Affairs,
Professor of Physics and Astronomy

The Making of a Scientist

In Ohio Wesleyan's Summer Science Research Program (SSRP), students learn quickly that authentic research is quite different from classroom labs—more challenging, more creative, more frustrating, and, ultimately, more rewarding.

I have always actively involved students in my research projects during the academic year and during the summers. The most rewarding part is watching the students grow as scientists, seeing them take command of a research project, and knowing that they are gaining the confidence to speak and act as scientists. Science cannot be learned solely from a book. Science must be experienced through research, and at OWU, we encourage students to plunge in, preparing them to be successful researchers both at OWU and at other universities. Many first-year students are surprised to learn that they can contribute in substantive scientific research from the moment they arrive on campus. At Ohio Wesleyan, research is not just for the few.

During the Symposium this afternoon, your will have the opportunity to interact with 15 students who performed research at OWU mentored by OWU faculty members, eight students from universities other than OWU who worked on campus with OWU faculty, and 16 OWU students who performed research off campus at other universities or in other countries. There is no doubt that the results presented here today are exciting and novel. However, equally exciting is the opportunity for you to speak with each of these young scientists about what discoveries they have made.

Enjoy the Symposium—and be sure to learn something new!

Laura Tuhela-Reuning
Department of Botany-Microbiology
Department of Zoology
Scanning Electron Microscopist
Summer Science Research Program Assistant Director



THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM ENDOWMENT

In 2006, Dr. Nancy Reynolds Schneider '64, established an endowment to name the Summer Science Research Symposium after her good friend and fellow OWU alumna, Patricia Belt Conrades '63.

Mrs. Conrades is a volunteer registered nurse and homemaker, and a member of Ohio Wesleyan's Board of Trustees. She regularly assists in the operating room of Boston's Mount Auburn Hospital. Dr. Schneider is a highly regarded Professor of Pathology and Director of the Cytogenetics Laboratory on the faculty of the University of Texas Southwestern Medical Center in Dallas. She also has served on the Ohio Wesleyan Board of Trustees.

Mrs. Conrades and Dr. Schneider share a commitment to the sciences, and both are examples of individuals who have enjoyed successful careers in science. The support of Mrs. Conrades and her husband, George Conrades '61, a member of the OWU Board of Trustees, and Dr. Schneider and her husband, John Schneider, continues to strengthen the science and mathematics programs at OWU.

Special Acknowledgments

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Support for the Patricia Belt Conrades Summer Science Research Symposium

Dr. Nancy Reynolds Schneider '64

Board 1

HAO DO AND YIXIN LIU

Faculty Mentor: Craig Jackson
Department of Mathematics and
Computer Science

The Hawk-Dove Evolutionary Game models the evolution of a population of animals that have two distinct types of behaviors: aggressive (Hawk) and cooperative (Dove). In this simple model, one of the crucial assumptions is that the traits or resources (fitness) gained over a life-time of an organism, which are favorable for reproduction, are not passed on to its offspring. However, in certain cases, inheritance of such 'fitness' can be justified, hence we allow a constant portion of it to be passed on (soft-inheritance) and seek to examine the effects of this modification. By using numerical and analytical methods, we find significant changes compared to the older Hawk-Dove model, such as the dependence of the percentage of Hawk-behavior in the long-run on how much inheritance is allowed after each generation of organism.

SOFT INHERITANCE IN THE HAWK-DOVE EVOLUTIONARY GAME

The Hawk-Dove game models the evolution of a two-phenotype population where reproduction is directly related to Darwinian fitness and fitness is non-heritable. However, there are cases in which a heritable fitness can be justified; for instance, if the resource being contested is extrinsic and infinitely divisible. We discuss methods of incorporating soft-inheritance in the Hawk-Dove game and examine its effect on population dynamics, both analytically and numerically. Under the soft inheritance assumption, the fitness (i.e., traits or resources acquired by an organism during its lifetime) of each phenotype (Hawk or Dove) is passed on to its offspring. Hence the fitness of each successive generation is not constant, but a function of population frequency. This results in a system of three coupled discrete difference equations. Our research seeks to examine the difference between the traditional model and model in which soft inheritance is allowed. We primarily focus on proportional inheritance, wherein heritability coefficients Alpha and Beta (between 0 and 1) are introduced into the fitness formulae. We show that the equilibria in the new model depends on the relative values of Alpha and Beta and that the equilibrium of the original model is recovered only when Alpha and Beta are equal and less than 1. Further, we examine the stability of these equilibrium, both local and global, and discuss the interesting case, Alpha=Beta=1, in which the long-term dynamics exhibit highly oscillatory behavior.

Board 2

KRISTIN SCHWACHA

Faculty Mentor: Tami Panhuis
Department of Zoology

Two closely-related species of fish that give live birth to their offspring, *P. turneri* and *P. presidionis*, develop a placenta-like tissue for the delivery of nutrients to the fetus during pregnancy. The alpha-2 macroglobulin (A2M) gene produces an extremely versatile immunological molecule that may be involved in interactions between the mother and developing fetus. In our work to find out more about the A2M gene, we found multiple copies of A2M from a single individual of both fish species, suggesting that there are multiple copies of the gene in each individual fish. If there are multiple copies of A2M in each fish, the copies might pick up extra functions, including playing a possible role in protein interactions between the mother and fetus in the placenta.

POECILIOPSIS PLACENTA GENES: IS THERE DUPLICATION IN THE A2M GENE?

The sister species *Poeciliopsis turneri* and *P. presidionis* are live-bearing fish that have a placenta-like structure, a tissue used to transfer nutrients from the maternal bloodstream to the fetus. These fish were studied in order to better understand the interactions between maternal and fetal proteins in the placenta during pregnancy. One highly expressed gene in these fish placentas, also found highly expressed in mammalian placentas, is the protease inhibitor alpha-2 macroglobulin (A2M). This protease inhibitor has the potential to interact with many different types of molecules, such as proteases, growth factors, and cytokines, and could potentially be involved in the maternal-fetal conflict model of protein evolution. This model describes the evolution of elaborate interactions between maternal and fetal proteins due to a potential intergenomic conflict of interest. For this particular experiment we sought to determine if A2M in the *Poeciliopsis* genome is a duplicated gene, as has been found for other bony fish. If A2M were duplicated, then the multiple copies of the gene would allow for the potential for a more versatile functionality of A2M, increasing the likelihood that it could play a role in a maternal-fetal conflict. To determine if A2M is duplicated, approximately 20 clones were sequenced from the placenta cDNA of a single individual for both *P. turneri* and *P. presidionis*. The cloned sequences were aligned and analyzed for sequence hetergeniety. For both species we found variation in the form of single nucleotide substitutions, some of which were replicated in multiple clonal sequences both within and between taxa. This suggests that A2M may be duplicated. Southern blot analysis will be used to confirm the potential A2M duplication within the *Poeciliopsis* genomes.

Board 3

JACOB DODD AND ANNA HOFFMAN

Faculty Mentor: Jennifer Yates
Department of Psychology

Currently 1,250,000 people live in the United States with a traumatic spinal cord injury. Our lab is developing various behavioral measures such as the incline plane apparatus, air righting, and contact righting to quantify the extent of injury in the guinea pig model. Using these behavioral measures, future research will assess various therapeutic interventions for spinal cord injury.

DEVELOPMENT OF FUNCTIONAL MEASURES IN A GUINEA PIG MODEL OF SPINAL CORD INJURY

Researchers using the guinea pig model of spinal cord injury (SCI) have previously used basic functional measures such as the placing and toespread responses and the *cutaneus trunci* muscle reflex (Blight et al., 1990; Blight, 1994; Blight et al., 1995; Yates et al., 2007). The limitations of these measures include a ceiling effect and insufficient sensitivity that may hide functional improvements and treatment differences. Several measures that have previously been used in rat spinal cord injury studies were tested in the guinea pig model including air righting behavior (Pellis et al., 1996; Wayner et al., 2000) contact righting behavior (Bouet et al., 2004), open field activity and the incline plane apparatus (Fehlings & Tator, 1995). Preliminary results show injury severity-dependent changes in function for air righting with mixed results for contact righting and no differentiation for open field activity. Inter-rater reliability is also high in the air and contact righting measures. Preliminary data acquired from the incline plane apparatus indicates that the measure is able to differentiate amongst injury severities when classified by sensory and motor function.

Board 4

ZIJIE POH

Faculty Mentor: Brad Treees
Department of Physics and Astronomy

One of the technological applications of Josephson junction (JJ) is a compact microwave emitter. However, the power emitted by a single JJ is in the nanowatt range, which is too small to have any practical applications. This problem can be defeated if we can synchronize a group of JJs, so that the microwaves emitted have the same phase and frequency. Therefore, in this research, we study the synchronization behavior of the JJs theoretically.

SYNCHRONIZATION OF COUPLED JOSEPHSON JUNCTIONS

We study numerically the phase dynamics of coupled Josephson junctions in one and two plaquettes. The governing coupled, nonlinear equations are solved via the fourth order Runge-Kutta method. We look for evidence of both frequency and phase synchronization in the dynamic (oscillating) junctions of the plaquette(s). Frequency synchronization is attained when the phase difference of the dynamic junctions is independent of time. Phase synchronization is attained when the phase difference of the dynamic junctions is zero. We found that, for a single plaquette, frequency synchronization can be attained rather easily with even weak coupling, while phase synchronization can only be attained asymptotically as the coupling between the dynamic junctions is increased. For two plaquettes, frequency synchronization can be attained when a magnetic field is applied perpendicular to the plane of the plaquettes. The frequency synchronization is weak in that it is lost as the bias current driving the plaquettes is increased. Analysis of the phase synchronization of the dynamic junctions in a two-plaquettes array is in progress.

Board 5

NURUL ISLAM

Faculty Mentor: Robert Haring-Kaye
Department of Physics and Astronomy

Some atomic nuclei, such as those with an overabundance of neutrons relative to the number of protons, are so exotic that they survive only a billionth of a trillionth of a second before disintegrating. Although studies of such systems have proven essential to our fundamental understanding of nuclear structure, these nuclei are not found in nature but instead require specialized particle accelerator facilities in order to produce and detect them, such as the National Superconducting Cyclotron Lab (NSCL) at Michigan State University. This summer we started analyzing data from an experiment conducted at the NSCL that was designed in part to study ^{23}O, an exotic isotope of oxygen having 8 protons and 15 neutrons. Our analysis involved calibrating the many detector systems used to track the trajectories and measure the energies of the exotic nuclei, an essential component to understanding which events in our data belong to the disintegration of ^{23}O. Ultimately, this analysis could lead to a better understanding of how the neutrons are organized in this nucleus

SELECTIVE POPULATION AND DECAY OF NEUTRON-UNBOUND STATES IN ^{23}O*

Exotic neutron-rich nuclei play an important role in the understanding of the fundamental interactions that take place within the atomic nucleus. For example, a recent study of ^{24}O revealed that the overabundance of neutrons present in this isotope leads to a relative shift in the single-particle neutron valence states and a new closed shell at neutron number N = 16. The neighboring ^{23}O isotope has only one less neutron and would thus provide an excellent laboratory for testing the effects of the new shell closure in this mass region. The goal of this research is to measure the decay energy of ^{23}O as it decays to ^{22}O by neutron emission. The raw data for the analysis were obtained from an experiment that was performed at the National Superconducting Cyclotron Laboratory at Michigan State University. As a part of a larger collaboration, we have worked on several off-line calibrations of the many different detectors used to track the trajectories and measure the energies of the exotic nuclei, including four gas-filled tracking detectors, two energy-sensitive plastic scintillator detectors and one gas-filled energy detector. During the course of the experiment, these detectors showed fluctuations in their calibrations and these fluctuations could reduce the precision of the final decay energy measurement if left uncorrected. For example, the tracking detectors, which contain 128 charge collector pads, were calibrated so that when a beam of common charged particles passes over the pads, each pad registers the same output charge response. We also adjusted similar pads in the gas-filled energy detector so that when a particular beam of charged particles passes over the pads, the pads register the same charge distribution. These preliminary corrections are crucial to successful particle identification in the analysis.

Board 6

BHAVNA MURALI AND KEVIN BARBER

Faculty Mentor: Chris Wolverton
Department of Botany/ Microbiology

Plants grow in response to a number of different environmental stimuli. Our project focuses on (1) investigating the relationship between two such stimuli – gravity and nutrient availability and (2) quantifying the concentration of Pi in wild type roots. We are studying the effects of normal and low Pi environments on lateral root architecture of wild-type and phosphate transporter mutant seedlings. Understanding this relationship, will allow us to select for plants that have higher productivity and require fewer fertilizer inputs.

UPS AND DOWNS OF PLANT GROWTH

Plant roots display adaptive growth in response to various environmental stimuli, including gravity and nutrient availability. This adaptation plays a key role in the acquisition of water and minerals from the soil. Inorganic phosphate is important in plants as a component of metabolites such as DNA and RNA, and as an integral part of plant energy transformation. The limited availability of this nutrient restricts plant growth and causes a host of developmental changes. In previous studies, we observed that wild-type (WT) Arabidopsis plants grown on reduced-phosphate media exhibited an increased gravitropic response. In the present study, we sought to test further the relationship between phosphate availability and lateral root gravitropism by analyzing seedlings that carry mutations in the phosphate transporter genes PHT1;1 and PHT1;4, both of which are highly expressed in roots. Here we show that lateral roots in both mutant backgrounds show a gravitropic response that is similar to that of WT lateral roots grown in low phosphate conditions, reinforcing the findings from our previous study that reduced phosphate increases lateral root gravitropism. In addition, we sought to quantify the concentration of phosphate found in the roots of plants grown in normal and low phosphate media to ensure that the increased gravitropic response correlates with low phosphate levels in roots and is not the result of activation of a different pathway. Preliminary data indicate a significant reduction in phosphate for roots grown on low-phosphate media relative to that of roots grown on full phosphate media, supporting a direct link between phosphate concentrations and lateral root growth responses.

Board 7

ZEAL JAGANNATHA, OWU AND RONALD FENELUS, FLORIDA INTERNATIONAL UNIVERSITY

Faculty Mentor: Sean McCulloch
Department of Mathematics and Computer Science

In a public transportation system, it is important to know where to place bus stops and routes to reduce gas usage. Our research aims to find the best positions and connections of stops to reduce transportation costs. We attempt to find the best routes for individuals and for groups, and combine them in a way that is fair for everyone. Our results can also be applied to similar systems such as network design.

SHARED SHORTEST PATHS IN GRAPHS

Our research into the Shared Shortest Path Problem (SSPP) attempts to route a number of paths, called journeys, in a graph that split the costs evenly of common edges. There are several different ways to view the problem, measured by different metrics.

Our first metric attempts to minimize total cost, which is known to be NP-Complete. To approximate this, we used a heuristic based on the Minimum Spanning Tree. This heuristic outperforms other approximations in graphs where the number of journeys is greater than the number of edges, as it is more likely that each edge in the spanning tree is shared.

Our second metric is to treat each journey as an independent agent and attempt to find a Nash Equilibrium (NE) for the graph. From previous research on Congestion Games, we learned that NE always exist for all graphs, and created an algorithm that finds them quickly in practice by repeatedly attempting defections for each journey.

Additionally, we investigated a generalization of a Nash Equilibrium, and attempted to find a Strong Nash Equilibrium (SNE) for the graph. We found this to likely be NP-Complete, and that SNE are not guaranteed to exist for all graphs.

Board 8

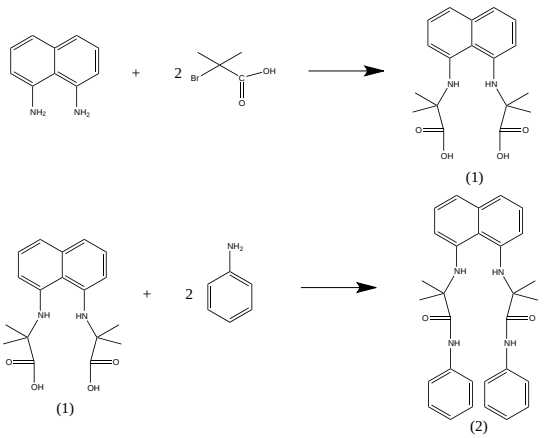
ADRIAN MORRISON

Faculty Mentor: Kim Lance
Department of Chemistry

My research group is working to create a robust catalyst that can purify water, an alternative to using environmentally unfriendly chlorine gas. The research involves working to synthesize a material that can stabilize iron molecules that is based on similar molecules found in nature. All work is done using green chemistry principles such as the use of benign reactants and reduction of waste.

SYNTHESIS OF LIGAND SYSTEMS TO SERVE AS ROBUST METALLO-ORGANIC OXIDATION CATALYSTS

Multiple methods for producing robust diamine diamide ligand systems were explored and an eective, two step synthetic pathway was determined. A diamine diacid intermediate (1) was synthesized and reacted with a coupling agent to form the diamine diamide napthal ligand (2). The diamine diacid synthesis was found to be ecient and high yielding and the amide formation step is under development. The ligand will stabilize high oxidation state metals which can be used as a green catalyst for water purication.



Reaction Scheme

Board 9

LOGAN MARKINS

Faculty Mentor: Kim Lance
Department of Chemistry

The most common method for water purification is chlorination, in which chlorine is used to neutralize the harmful effects of impurities. This method, although effective, also leads to the creation of various other products that are detrimental to human health. In nature this purification is accomplished though the use of iron-based compounds, which, upon usage, doesn't lead to the production of toxic side products. Using green chemistry principles, a molecule imitating those in nature can be artificially produced, in which its design and implementation reduces or eliminates the use and/or generation of hazardous substances.

PREPARATION OF COMPLEXES AS ROBUST CATALYTIC OXIDANTS

Several routes were explored in the synthesis of a diamine diamide ligand which were found to be thermodynamically unfeasible; alternative routes were then explored in the synthesis of diamide diamine ligands. In the synthesis of the diamine diamide, an intermolecular rearrangement occurred that led to a thermodynamically driven reaction of an undesirable end product. A different synthetic route was approached; the molecule was to be synthesized in the opposite manner from amide to amine to form the diamide diamine, compound 5. In this route, 2-aminoisobutryic acid, compound 1, was reacted with phthalic anhydride to produce the protected phthalimidopropanoic acid, compound 2. To this, thionyl chloride was added to synthesize the protected phthalimidopropanoic chloride, compound 3. To compound 3,o-phenylenediamine and triethylamine were added to yield the protected diamide diamine, compound 4. This was then deprotected with hydrazine monohydrochloride and triethylamine to give the diamide diamine, compound 5, confirmed by spectral analysis, using 13C NMR and 1H NMR. The ring closure of compound 5 is still being researched, in which the final ligand will be capable of stabilizing high oxidation state metals, and will be used as a green chemistry catalyst in water purification.

Board 10

EMILY KIOURTSIS

Faculty Mentors: Mindy Baker, Lynda Hall, and Harry Bahrick
Department of Psychology

The ultimate goal of our research is to find ways to stabilize access to information we have learned in the past. Older adults have trouble accessing information, especially the names of people. By testing older and younger adults on the names of famous people, we are hoping to measure different types of memory search people employ when trying to come up with the names of famous people they know. We believe the type of search people use may account for age related differences in recall.

THE EFFECT OF AGE ON TYPE OF SEARCH FROM SEMANTIC MEMORY

Not being able to come up with the name of someone you know is frustrating at any age. However, older adults have more instances when they are unable to come up with the name of a person they know compared to younger adults. When older adults cannot come up with a name they know, they spend more time than younger adults trying to recall it. Because of this, we wonder whether older and younger adults use different strategies to search for the information they are trying to access. Sometimes the name of a person one knows comes to mind immediately and without any thought, while other times recall of the name is delayed. With delayed recall, one may or may not need to think of information related to that person (i.e., what he/she was famous for) before recalling his/her name. The goal of this study is to identify the different types of memory search people use when trying to come up with names of people they know. This summer focused on developing procedures to categorize types of search. Older (ages 65 to 85) and younger (ages 18 to 25) adults were pilot tested. Each participant was shown approximately 300 black and white headshots of famous people on the computer and was asked to name them. After the participant's response, questions were asked regarding how he/she searched for the name of the person. Data from this summer will be used to select items and match item difficulty between older and younger adults for the final test. It will also be used to determine if the procedures effectively measure different search strategies before conducting research this fall.

Board 11

LAUREN LEISTER AND ALAN MASSOUH

Faculty Mentor: Danielle Hamill
Department of Zoology

In today's world of stem cell research and personalized medicine, embryology has never claimed more of the spotlight. With this in mind, our lab traveled to southern Florida and collected a number of microscopic roundworms related to the model organism, *C. elegans*. We have been characterizing the worms, sequencing a portion of the DNA, and studying their early embryonic development. The knowledge gained will be useful for comparing cell division and early development in other organisms. Comparative studies are important to understand the diversity of life.

ISOLATION, IDENTIFICATION, AND CHARACTERIZATION OF FREE-LIVING NEMATODES

All life forms begin as a single cell, which may develop into a complex multi-cellular organism. Our lab is interested in cell division and early developmental processes. Nematodes, which include the rhabditids, are one of the most common phyla of animals, and *Caenorhabditis elegans* is the best studied of the rhabditids. We seek to understand the similarities and differences between *C. elegans* and other rhabditids. Toward this end, we traveled to southern Florida to isolate additional nematodes for further characterization. Many free-living nematodes spend part of their life cycle in association with millipedes. Therefore we collected millipedes as well as soil samples to search for nematodes. We have been able to culture 27 of these worms with reagents and techniques used for *C. elegans*. We are using a combination of phenotypic and molecular techniques to characterize and identify these worms. We have photographed and measured the worms, taken movies of their embryos, and used immunofluorescence microscopy to visualize sub-cellular components. We have found worms without tails, and others with tails much longer than *C. elegans*. We have observed differences in the overall size of the worms, in the gonads, in embryonic development, and more. Furthermore we have isolated genomic DNA from each strain, amplified part of the 18s rDNA gene using PCR, and sent these samples for DNA sequencing. The sequences were compared to each other as well as to other sequences in public databases. We believe that the worms we collected represent four to six species, and some may represent previously undescribed species. Additional phenotypic and DNA sequence analysis will be needed to confirm this. We believe that comparative studies like this will not only help us to better understand an important phylum of animals, but will help us to understand cell division and developmental patterns more broadly.

Board 12

BRADLEY TURNWALD

Faculty Mentor: Herbert L. DuPont
Center for Infectious Diseases, The University of Texas
School of Public Health

Clostridium difficile is the bacterium that causes antibiotic-associated diarrhea in a condition known as *Clostridium difficile* infection (CDI), a potentially serious complication for elderly and infirm hospitalized patients. Little is currently known about the inflammatory immune response that CDI causes in the human host. The aim of this study was to compare the immune responses in CDI-positive patients to those of CDI-negative patients by measuring the levels of a multitude of known immune system proteins. Several immune system signaling proteins were observed to be elevated in CDI-positive patient stool samples compared to CDI-negative patient stool samples, and these proteins may allow for a new approach to improving diagnosis and treatment of CDI.

CHARACTERIZATION OF THE INFLAMMATORY IMMUNE RESPONSE TO *CLOSTRIDIUM DIFFICILE* INFECTION

Clostridium difficile infection (CDI) is the leading cause of antibiotic-associated diarrhea (AAD) and is a major source of nosocomial infection worldwide. CDI develops in patients when broad-spectrum antibiotic use wipes out competing gut flora, allowing the spore-forming *C. difficile* to proliferate opportunistically in the colon and release toxin A and toxin B, which are responsible for the clinical manifestations that can range from mild diarrhea to pseudomembranous colitis and death. Current diagnostic methods for CDI are not specific enough to accurately distinguish between patients with CDI and those who are simply colonized, leading to unnecessary and expensive antibiotic treatment for patients improperly diagnosed with CDI. The aim of this study was to characterize the inflammatory immune response in patients with CDI to look for fecal inflammatory markers that may improve the identification of CDI and be a basis for the differentiation between infected and colonized patients. To investigate the role played by a multitude of fecal inflammatory markers in CDI, stool samples from CDI-positive patients were tested against CDI-negative AAD control stool samples for the expression levels of thirty-six different cytokines and chemokines as well as lactoferrin and calprotectin concentrations using enzyme-linked immunosorbent assay (ELISA) methods. CDI-positive stools had elevated expression levels of more proinflammatory cytokines and chemokines such as IL-8 and IL-23 as well as higher concentrations of the proinflammatory innate defense proteins lactoferrin and calprotectin compared to CDI-negative stools. No difference was observed between CDI-positive and CDI-negative stools for many key Th1 and Th2 cytokine expression levels, such as TNF-α, IL-2, IL-12, IL-6, IL-10, and IL-13, suggesting that the inflammatory immune response to CDI is a mixed Th1/Th2 response that is proinflammatory but not robust.

Board 13

ANDREA HATFIELD

Faculty Mentor: Amori Mikami
Department of Psychology, University of Virginia

Children with attention-deficit/hyperactivity disorder (ADHD) are prone to suffering peers difficulties, but little research has looked at the quality of their friendships. This study asked 1st through 3rd graders with and without ADHD to name their friends. Friend pairs then completed a friendship quality survey and toy-sharing task. Results are compared by ADHD-status and implications for future research are given.

FRIENDSHIP QUALITY IN CHILDREN WITH AND WITHOUT ADHD

While peer rejection has been well studied in children with attention-deficit/hyperactivity disorder (ADHD), little research has examined close friendships in this population. Intimate reciprocated relationships are important because high-quality friendships may buffer the consequences of peer rejection and other negative effects of ADHD. To help bridge this gap in the literature, the current study compares sociometric status and friendship quality in children with and without ADHD. First through third grade children participating in a larger friendship intervention study underwent standard sociometric interviewing. Pairs of students who mutually nominated each other as friends (n=41) filled out a friendship quality survey and completed a structured toy sharing task. While results are limited by the small number of ADHD/ADHD (n=4) and ADHD/typical dyads (n=5), implications of these preliminary findings are given and recommendations for future studies are made.

Board 14

BENNETT THOMPSON

Faculty Mentor: Andy Harned
Department of Chemistry, University of Minnesota

In general, there are two types of scientific research. Applied science seeks to use existing knowledge to innovate new technology. In complement to applied science is pure (or "basic") science, which attempts to uncover the fundamental principles behind how nature works.

This summer, I contributed to the development of new compounds and chemical reactions that can be used in chemical synthesis. This pure research, while not making plastics or pharmaceuticals directly, is part of a larger, behind-the-scenes process of giving applied chemists an ever-widening set of tools by which to direct the transformation of matter and make new molecules.

NEW REAGENTS AND REACTIONS IN THE OXIDATIVE DEAROMATIZATION OF PHENOLS FEATURING HYPERVALENT IODINE

The development of catalytic and enantioselective oxidative dearomatization of phenols would provide a simplified route to dienone building blocks for natural product synthesis. Novel benziodazole triflouroacetates were prepared from the reaction of 2-iodobenzamides with Oxone in the presence of triflouroacetic acid. This synthesis provides species that may be used as novel reagents for the dearomatization of phenols. In pursuit of greater enantioselectivity, C2-symmetric aryliodine precatalysts were also explored.

Board 15

NASIE CONSTANTINO

Faculty Mentors: Shobha Potlakayala and R.V. Sairam
Department of: Environmental Engineering, Penn State University, Harrisburg

As gas prices rise, more and more interest is being given to researching and developing sustainable bioenergy. One substitute that has been explored is biofuels, which is the use of plant material to produce oil that can be used as a substitute for diesel; also known as biodiesel. *Camelina sativa* is one plant that can produce 25-35% of its seeds into biodiesel. To increase the amount of biodiesel one acre can produce, the plants themselves need to be protected from the harsh environment containing pathogens that can damage them, resulting in lower biodiesel yields and an increase in production costs. The objective of my study was to genetically transform *Camelina* using a bacterium known as *Agrobacterium tumefaciens* that encodes for a broad-spectrum disease resistance gene known as AtNPR1.

ENGINEERING DISEASE RESISTANCE IN *CAMELINA SATIVA*

The use of biofuel is attracting a large amount of interest recently given the rising price of gas and the need to reduce dependence on importing oil. Recently, attention has been drawn towards a promising second generation biofuel plant- *Camelina sativa*. *Camelina* is able to produce 25-35% oil from its seeds into a biodiesel with a relatively inexpensive process. *Camelina* is affected by many of the same diseases found in other members of the *Brassicaceae* family. Hence our objective is to introduce a board spectrum disease resistance gene called *Arabidopsis thaliana Non-expressor of Pathogenesis Related gene (AtNPR1).* By introducing this gene into the plants, the plants will be able to protect themselves from pathogens and produce more seeds to be used for biodiesel. In our current study, we transformed *Camelina* cotyledon and young leaf explants using Agrobacterium mediated transformation using both marker genes, *Glucouronidase* (GUS) and *Green Florescent Protein* (eGFP), and AtNPR1 gene. Six sets of transformations were performed and 190 calli and 22 shoots were regenerated from these experiments. Preliminary results are promising, indicating high frequency of transformation.

Board 16

KELLIE GROSS

Faculty Mentor: Anthony Windebank
Department of Neurology
Mayo Clinic, Rochester, MN

Functional recovery after spinal cord injury may be improved by inhibiting immune responses that cause secondary damage at the injury site. Glycodelin-A (GdA), an immunosuppressive glycoprotein, may be therapeutically useful for this reason; however, a viable method of delivering GdA into the CNS is needed. This work was aimed at furthering the development of a viral method of GdA production. Specifically, the biological activity of the GdA protein expressed from the virus was tested.

DEVELOPING A LENTIVIRAL VECTOR FOR GLYCODELIN-A EXPRESSION

Inflammation and immune response after spinal cord injury (SCI) result in secondary damage characterized by an expansion of the initial lesion. In order to promote functional recovery after injury, therapies designed to inhibit these mechanisms are being developed. Glycodelin-A (GdA), a glycoprotein shown to induce apoptosis in T cells, may be useful in preventing some of the immune mediated aspects of secondary damage. However, a viable method of sustained GdA delivery to the CNS does not exist. A lentiviral vector expressing GdA that could be used to transduce mesenchymal stem cells for implantation into the subarachnoid space may offer a solution to this problem. To further the development of this method, the biological activity of GdA expressed from a lentivirus was studied. T cells were transduced with a GdA lentiviral vector and examined for signs of apoptosis using flow cytometry. Analysis showed no evidence of apoptosis being induced in the T cells expressing GdA. This result suggests that the GdA expressed from the lentiviral vector is not biologically active. Lack of biological function may be due to the inability of T cells to properly glycosylate GdA after translation. Future work may seek to compare the glycosyltransferase activity in endometrial cells that endogenously produce GdA to that in T cells.

Board 17

CHRIS BROOKS

Faculty Mentor: Wenrui Duan
Department of Medical Oncology, The Ohio State University Medical Center

A majority of lung cancer cases contain a mutation in a specific area of the human genetic code, a region called p53. A molecule known as PRIMA-1 has been shown to revert mutated p53 to its normal function. Mice that possessed a p53 mutation and subsequently developed lung cancer were treated with PRIMA-1 and the change in tumor volume was measured using CT scans. The results indicated that mice with lung cancer treated with PRIMA-1 are more likely to have tumors that stabilize or decrease in size when compared to those mice with lung cancer not treated with PRIMA-1.

TREATMENT OF SPONTANEOUS NON-SMALL CELL LUNG CANCER VIA PRIMA-1

Lung cancer takes more lives than any other cancer in the United States. Worldwide, it claims more than 160,000 lives annually. 75%-85% of lung cancers are non-small cell cancers. Of those non-small cell cancer cases, 50%-60% contain p53 mutations. Additionally, 90% of small cell cancer cases contain p53 mutations. These statistics demonstrate that p53 missense mutations are among the most common genetic events in cancer development. A molecule, called PRIMA-1, has been shown to revert mutant p53 to wild-type function by either inducing massive apoptosis or decreasing the rate of cell proliferation in lung tumor cells. To investigate whether the treatment of spontaneous non-small cell lung cancer in a murine model with PRIMA-1 can halt tumor growth or shrink tumor size, murine models with a lung specific p53 mutation and lung tumors were treated with PRIMA-1 and the change in tumor size was detected. Mice with the human mutant p53(273H) expressed in a lung specific manner and under control of the surfactant protein C promoter were treated with PRIMA-1 for two weeks. The change in volume was calculated using estimations derived from micro-CT images. The change in volume was interpreted as follows: complete response – disappearance of all tumors, partial response – 50% to 100% reduction in tumor volume, stability – 25% increase to 50% reduction in tumor volume, and tumor progression – 25% or greater increase in tumor volume. The results indicated that spontaneous non-small cell lung cancers treated with PRIMA-1 are more likely to have tumors that stabilize or decrease in size than spontaneous non-small cell lung cancers not treated with PRIMA-1. Further research is necessary that investigates the mechanism behind the stabilization or decrease in size, especially to determine whether PRIMA-1's effect is derived from an increase in the rate of apoptosis or a decrease in the rate of cell proliferation.

Board 18

CLARE EDWARDS

Faculty Mentor: Jennifer Yates
Department of Neuroscience and Psychology, Ohio Wesleyan University

AssureRx Health, a pharmacogenetics company based in Mason, Ohio, provides personalized medicine profiles via genotype testing to patients suffering from psychiatric disorders. GenesiteRx, their current product, tests 6 genes that have to do with the enzymes involved in drug metabolism (for antidepressant and antipsychotic drugs). To expand the testing platform, current scientific knowledge from published studies needs to be reviewed and cataloged. Finding trends in this research connecting genes to other conditions, for example chronic pain, could help to generate a more extensive, further-reaching, genetic test.

PHARMACOGENETIC RESEARCH IN OPRM1 AND ANALGESIC DRUGS (REVIEW)

AssureRx Health, a pharmacogenetics company in Mason, OH currently conducts genotype testing to improve drug treatment, specifically the prescription of antidepressants and antipsychotics. The test, GenesightRx, provides a personalized medicine profile for individual patients consistent with how well the enzymes in their liver are predicted to metabolize certain drugs according to their genotype. To extend the testing platform past antidepressant and antipsychotic drugs, the research and development team is continually reviewing and cataloging new research in hopes to add new drugs and disorders/conditions to the assessment. One of multiple projects meriting attention is the A118G polymorphism in the OPRM1 gene. A trend in published studies pertaining to this SNP has been discovered and is undergoing closer analysis. It appears that the efficacy of receptor binding in patients carrying one or two of G variant alleles is lower than that of those homozygous for the wild type A allele. If this genetic polymorphism can be proven to help predict dosage of analgesics, it could greatly improve therapeutic pain management and decrease respiratory depression and other dangerous side effects of analgesic drugs.

Board 19

MICHELLE JANE LEE

Faculty Mentor: Karnyupha Jittivadhna
Institute of Innovative Learning, Mahidol University, Bangkok, Thailand

AN INTERACTIVE AND VERSATILE DNA MODEL: AN INTUITIVE APPROACH TO TEACHING

A longstanding challenge for Biology teachers is to assist students in making the jump from memorizing facts to understanding intuitively how the cellular machinery functions and interacts with its environment. In face of the challenge, we introduce a new and effective way of teaching Biology, beginning with DNA – a model that mimics how DNA responds to the intracellular environment. This constitutes an improvement from past models that only focus on the physical characteristics of DNA, omitting its involvement in various processes. The versatility of our model lies in its ease of use over various levels of magnification – from chemical formulae to the nucleotide and the double helix. The model is made of a durable plastic material, and its sturdy design allows the model to withstand repeated rough handling. Most importantly, with only basic office supplies, one can cheaply and easily make the model.

Board 20

ABIGAIL DOCKTER

Faculty Mentors: Nancy Murray and David Johnson
Department of Botany/Microbiology, Ohio Wesleyan University

Plant remains from archaeological sites, although often sparse, can contribute immeasurably to our knowledge of people in the past. Charred wood and seeds from a number of sites in the Goodman Point Community were identified under the microscope to gain information about the types of plants people were using and how they utilized them. This information will be used in conjunction with other data from the site to provide a more complete understanding of the lives of ancient people in southwest Colorado.

ANALYSIS OF MACROBOTANICAL REMAINS IN THE GOODMAN POINT COMMUNITY

Organic materials do not often survive in the soil for long periods of time, and this pattern of preservation affects archaeologists' understanding of the people and the material culture they study. However, there are situations where plant remains can be preserved for hundreds of years. Carbonizing or burning plants slows their decay, and ancient peoples often unintentionally carbonized their dinners as well as their wood fuel. These remains can be identified under a microscope and used to contribute to our knowledge of people in the past and their relationship with the environment on which they depended.

One method of obtaining botanical information from an archaeological site is to float a soil sample, separating the organic material from the inorganic. This method reveals primarily ancient charred wood and charred seeds, which are identified based on specific characteristics and direct comparison to modern plant parts. The summer's research focused on the botanical record from the Pueblo III time period (1200-1350 BC) through identifying plant parts recovered from the Goodman Point Community in southwestern Colorado. Identification of plant taxa present in this archaeological record can provide direct information about what people in this site were growing, gathering, cooking, and burning, and can be combined with other lines of evidence to tell a story of their relationships and activities.

Board 21

SARAH JOHNSTON

Faculty Mentor: Shem Mwasi
Department of Wildlife Management, Tanzania

National parks are one type of protected area in Tanzania that are set aside and managed under appropriate legislation for wildlife. Counts are performed in order to assess various statistics concerning the species populations within the park. A sample count is a direct method by researchers/government officials to determine the carrying capacity of the park, the conservation status of species, population dynamics/trends, and the correlation to tourism involving the marketing of the park's large mammal resources. A count performed in Tarangire National Park demonstrated a moderate level of species diversity, which suggests a connection between species diversity, location, and time of year for the habitats within the park.

AN ASSESSMENT OF THE LARGE MAMMAL POPULATION DIVERSITY IN TARANGIRE NATIONAL PARK

Management and conservation of large mammals requires information on the number of species within the protected area. Mammal counts allow for researchers to evaluate population dynamics and population trends as well as linking the studies to affects on tourism. Road counts are useful where vehicle access is possible and small count zones are employed. Large mammal resources, defined in the study as any mammal larger than Kirk's Dik-dik (*Madoqua kirkii*), in Tarangire National Park (TNP) are assessed in this study using the road count method and compared them to other protected areas in Tanzania. This includes large mammal species diversity, density of large mammals in the habitats which can be found within TNP. Simpson's diversity index (D2) and species densities were calculated to examine the total species count, the population diversity, and the proportion of certain species from the total in order to analyze the species diversity within TNP. The data suggests the species diversity at Tarangire National Park is moderate (0.518) which may be due to the location of the sample zone. The sample was taken from the northern area of the park where roadways are present possibly causing movement of some timid species away from the area. The mammals with the highest densities (Common Zebra and Brindled Gnu) contributed to the large proportion of grazers which identified as the most prominent species of feeders present in the zone. The large proportions of herbivores in the area are probably due to the time of the year in which the study was conducted.

Board 22

SHARIF I. KRONEMER AND GUANYI YANG

The goal of our research was to learn how China's water crisis can educate the world on global water pollution and scarcity. Meeting with NGOs, government officials, professors, Ph.D. students, and villagers, and testing water quality across China provided an in-depth view of the impact of the water crisis. With this insight we can predict the future of China's water supply and educate the world on solutions to similar water calamities across the world.

CHINA'S WATER CRISIS AS A MODEL FOR GLOBAL WATER SCARCITY

On every continent there is evidence of economic, political, and physical stress due to water scarcity. Asia and Africa have been particularly devastated as climate change and mismanagement have turned lush countries into deserts. Through in-depth research of one of these crises, the world can learn about policies and actions to be taken to alleviate the crisis in their own country. China is an ideal model because it represents a modern and industrial nation that parallels the United States. Over a three-week trip to China, the cities of Beijing, Xi'an, Shanghai, and Chengdu were assessed. Meeting with NGOs, government officials, villagers, professors, and PhD students were arranged who are confronting China's water crisis at different levels. Details about research, policies, and personal accounts were recorded. Also, test strips were used to test pH, hardness, and alkalinity of water of all sources across China. These meetings and tests revealed a dire crisis that has only recently been confronted. Water pollution was found to be a primary cause of fresh water scarcity in China. Yet, many people are devoted to the cause of cleaning Chinese water. Progress towards this goal should be expected in the next decade. Future research will include assessing how Chinese policies and research can be implemented in the U.S.

Board 23

SRIHARSHA MASABATHULA

Faculty Mentor: John Krygier
Department of Geography

As climate change is increasingly becoming a matter of concern around the world, carbon trading has emerged as a "business unusual" model to help mitigate it. Carbon Credits can now be generated by using Afforestation / Reforestation (A/R) techniques to bring down emission levels in the atmosphere. My research is focused on determining lands for project development to generate Carbon Credits under international mechanisms such as the Clean Development Mechanism of the United Nations Framework Convention for Climate Change (UNFCCC) and Voluntary Carbon Standards using Geo-spatial technologies.

MAPPING CARBON CREDIT ELIGIBILITY

Climate change and poverty are significant global as well as local problems. In order to address these concerns effectively, climate change strategies need to be integrated with poverty alleviation programmes. The Clean Development Mechanism in the context of the United Nations Framework Convention on Climate Change (UNFCCC) / Kyoto Protocol and Voluntary Carbon Standards (VCS) provide an opportunity to mitigate climate change through afforestation and reforestation of degraded lands generating Carbon / Social Credits which provide additional income to the poor farmers enhancing their livelihoods.

To be eligible for carbon credits, the land being used must not be currently forested (2011) and not have been forested 20 years ago (1990). The standards for defining a forest vary for each nation. In our case – India – forest is defined as having a minimum surface area of 500 m2, minimum tree crown cover of 15% and a minimum height of 2 meters.

To determine these kinds of lands, tools such as Geographical Information Systems (GIS) can be useful to superimpose the 1990 data on the current year data (2011) to identify eligible lands. Once eligible lands are mapped using Earth imagery, image analysis, and GIS, a method for linking these areas to property owners must be determined. In many places in the world property records are stored on paper maps, which call for digitization of the available data to meet our requirements. Subsequently, project development would be undertaken under various standards such as CDM and VCS to generate credits.

My research seeks to study imagery, image analysis software and a process for generating digital property record data that is cost-effective for those areas of the world that don't have access to resources that universities and colleges have. This will make the generation of carbon credits a viable option to provide benefits both locally and globally.

Board 24

TAMMY WINKLER

Faculty Mentors: Eujin Lim and Marc Rothenberg
Department of Allergy and Immunology, Cincinnati Children's Hospital

Eosinophilic Esophagitis (EE) is a severe inflammatory disease of the esophagus marked by an accumulation of eosinophils, a type of white blood cell, in the epithelial layer of cells. Eotaxin-3 is the gene most highly upregulated in patients diagnosed with EE. We are trying to elucidate the mechanisms by which eotaxin-3 gene expression is regulated. We focus on the possible role of epigenetics in the induction and maintenance of eotaxin-3.

THE EFFECT OF IL-13 ON HISTONE MODIFICATIONS AND EOTAXIN-3

Eosinophilic Esophagitis (EE), an inflammatory disease of the esophagus, is associated with the overproduction of interleukin-13 (IL-13), a Th2 cytokine, and eotaxin-3, an eosinophil-specific chemoattractant. Herein, we focus on the role of IL-13 in the regulation of histone methylation and eotaxin-3. Esophageal epithelial cells were incubated with IL-13 (chronic group) and without IL-13 (medium group) for 2, 4 and 6 days. Following cessation of IL-13 exposure, eotaxin-3 mRNA levels were continuously detected at 4 days (IL-13 medium group), and was ~30 fold greater than eotaxin-3 levels at 2 days. Esophageal epithelial cells were also re-exposed to IL-13 after four days without IL-13. After re-exposure, eotaxin-3 levels increased to the same level as continually treated cells. Western Blot analysis of IL-13 treated esophageal epithelial cells revealed that IL-13 increases global histone 3 acetylation specifically at Lys 23 and Lys 56, but not at Lys 9 or Lys 14. IL-13 treated esophageal epithelial cells also showed an increase in histone 3 methylation at Lys 4 (H3K4me3), a marker for transcriptional activation, and a decrease in histone 3 methylation at Lys 27 (H3K27me3), a marker for transcriptional repression. These results indicate that IL-13 affects histone 3 acetylation and methylation and eotaxin-3 induction and maintenance.

Board 25

KASSEL GALATY

Faculty Mentor: Paul Shaw
Department of Anatomy and Neurobiology at Washington University in St. Louis

Mutations in the presenilin (*psn*) gene are attributed to causing familial forms of Alzheimer's disease. A *Drosophila* mutant with reduced psn activity was found to have similar sleep patterns as they aged, as humans with Alzheimer's disease have as they age. These flies can therefore be used to see if sleep therapy can help reverse or restore the cognitive deficits found in Alzheimer's patients.

CAN SLEEP THERAPY IMPROVE THE PATHOLOGY IN A *DROSOPHILA* MODEL OF ALZHEIMER'S DISEASE?

Two of the most prominent characteristics of Alzheimer's disease are fragmented sleep and decreased functional and behavioral plasticity. Dominantly inherited Alzheimer's disease is attributable to reduced levels of presenilin (*psn*) activity. Presenilin genes are part of the gamma secretase intermembrane protease complex and are believed to help regulate production of amyloid beta. In flies, a model has been developed that disrupts *psn* function, resulting in age-onset impairments in memory and learning, similar to the deficits see in familial forms of Alzheimer's disease in humans (McBride *et al.*, 2010). Whether fragmented sleep affects memory impairment in Alzheimer's disease is still unknown. In order to address this question in *Drosophila*, we needed to establish what the sleep patterns of young and old *psn* flies were in comparison to the control strain. We compared the sleep patterns of young (5-day old) and old (26-day old) *psn* flies with young and old *Cs* flies. We found that *psn* flies show a similar sleep pathology to Alzheimer's patients. With this knowledge we hope to determine whether sleep enhances or degrades the cognitive deficits experienced by Alzheimer's patients; whether age dependent sleep changes can be reversed using pharmacologically or genetically inducing an increase in sleep; and whether sleep therapy can restore age-dependent decreases in functional and behavioral plasticity.

Board 26

ALLISON KOLBE

Faculty Mentor: David Jackson
Department of Plant Biology, Cold Spring Harbor Laboratory

Plant development is controlled by intricate combinations of genetic and environmental factors. I studied two maize mutants with developmental abnormalities to determine whether the two mutated genes normally interact in the process of development. I also studied the effect of a developmentally important plant hormone, gibberellic acid, on the size of the stem cell population of the plant.

DETERMINATION OF PHYLLOTAXY IN MAIZE BY REDOX REGULATION OF TRANSCRIPTION FACTORS

The shoot apical meristem (SAM) is a reservoir of stem cells responsible for vegetative and reproductive growth of plants. The dynamic activity of the SAM affects the geometric patterns of leaf and flower development, called phyllotaxy. We are studying the dominant mutant *Abph2* (*aberrant phyllotaxy 2*) which is characterized by an enlarged SAM and abnormal decussate phyllotaxy, in which leaves form in opposite pairs. Preliminary data show that *Abph2* encodes a glutaredoxin protein, which we are in the process of testing via an enzyme activity assay. A second mutant recently cloned in our lab, *fea1905*, has an enlarged SAM, fasciated ears and tassels, and encodes a bZIP transcription factor. Close homologs of *ABPH2* and *FEA1905* in *Arabidopsis* have been shown to interact in the process of anther development. As a result, we wanted to determine whether these genes also interact in maize. Protein-protein interactions were assessed using three different tests: yeast two-hybrid, co-immunoprecipitation, and bimolecular fluorescence complementation (split-YFP). The yeast two-hybrid and immunoprecipitation assays require additional work to be optimized for this system; however, preliminary results from split-YFP show a positive interaction between our genes of interest. Assessing the interaction of these genes is an important step in studying how these two genes are involved in determining maize phyllotaxy and meristem size. In addition, a preliminary study on *fea1905* showed that the enlarged SAM phenotype can be rescued by treatment with the plant hormone gibberellic acid (GA). Therefore, we were interested in studying this effect on our enlarged meristem mutant, *Abph2*, to evaluate the role of GA in determining meristem size. Although the mutants were still responsive to GA and meristem size was reduced, GA-treated mutant meristems were still significantly larger than wild-type. High variability in the data also limits our ability to draw strong conclusions from this experiment.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Madras
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YEMEN
Coimbatore
Jaffna
SRI LANKA
Colombo
Socotra
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Mogadishu
Chagos
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Mahajanga
Toamasina
Rodrigues
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MAURITIUS
Port Louis
St.-Denis
Mascarene Islands
Réunion
(FRANCE)
MADAGASCAR

Established in 1994, this award is presented to students interested in health-related careers.

Board 27

ADELINE HEMMEN

Faculty Mentor: Hrishikesh Kumar
Institution: Institution of Neurosciences Kolkata

Four weeks were spent interning abroad at the Institute of Neurosciences Kolkata in West Bengal, India. The public health project was completed in order to acquire a basic understanding of the medical system in India and, specifically, the treatment of neurological disorders in the region. Additionally, a foundational knowledge of basic clinical neurology was gained.

HOSPITAL-BASED PRACTICUM ON THE TREATMENT OF NEUROLOGICAL DISORDERS IN WEST BENGAL, INDIA

The Hospital-Based Practicum on the Treatment of Neurological Disorders served to broaden understanding and knowledge of the treatment of neurological disorders internationally. Four weeks were spent interning under the supervision of Dr. Hrishikesh Kumar at the Institute of Neurosciences Kolkata (INK) in West Bengal, India. The internship was designed with the assistance of Dr. Herbert DuPont (OWU Class of 1961), the vice chairman of the Department of Medicine at Baylor College of Medicine. A basic knowledge of the medical system of India was gained in addition to an understanding of how the pharmacy, nurses, physicians, operating room staff, and other medical personnel work together at the INK in particular to address the neurological problems facing West Bengal and India. Additionally, skills to prospectively review literature on important public health and neuroscience topics were employed and the importance of neurological treatment facilities in India was highlighted. Procedures and tests used to treat and diagnose patients were learned. Time was spent with hospital staff to understand how the team works together to treat patients, daily task force meetings were attended, regular rounds with Dr. Kumar were made, various types of treatment available were witnessed, patient histories in the clinic were taken, and both common and exotic neurological conditions seen in both in- and out-patients were discussed with Dr. Kumar. The supervisor took daily assessments of the clinical material being taught. Upon the completion of the internship, a greater understanding of the Indian medical system and a basic clinical knowledge of neurological disorders were acquired.


APS

The NSF-funded REU/RET (Research Experience for Undergraduates/Teachers) program at Ohio Wesleyan makes it possible for students from universities across the country, as well as one or two high-school science teachers from central Ohio, to do research in the fields of astronomy, computer science, mathematics, and physics on the OWU campus.

Board 28

CHRISTIAN BUENO,
FLORIDA INTERNATIONAL UNIVERSITY

Faculty Mentor: Craig Jackson
OWU Department of Mathematics and Computer Science

From supercoiled DNA to tangles in your hair and even Celtic art, the twisty-turny mathematics of tangles and string links play a part. These objects have a natural algebraic structure that is complex and so representation theory is employed to simplify their study. The skein representation and a representation of X.S. Lin are two wildly different approaches for dealing with string links, yet they surprisingly agree on infinitely many cases. Our research aims to show that the Lin and skein representations don't just coincidentally agree, but are in fact two sides of the same coin.

REPRESENTATIONS OF STRING LINKS AND TANGLES

The string link monoid is a generalization of the braid group created by allowing the strands of braids to loop and knot. We consider two representation on string links that extend the Burau representation of the braid group. The first, due to X. S. Lin, is defined probabilistically via sums of weighted paths along strands of the link. The second is a combinatorial/topological representation defined by recursively applying the Conway skein relation to the string link, resolving it into braids on which the representation takes the familiar form of Burau. We show that these two representations agree over many nontrivial string links. These calculations support the conjecture by T. Kerler that these representations are identical. In further investigations, we consider the case of 2-strand string links in depth, relating it to the theory of rational tangles. We define a natural extension of Lin's representation to generic tangle diagrams and compute several examples. Lastly, we give one consequence of the conjecture, namely, a formula relating the Alexander polynomial of a closed string link to its matrix entries under the representation.

Board 29

PAULA JOHNS
NORTHERN ARIZONA UNIVERSITY
AND SARAH KRUG
UNIVERSITY OF NOTRE DAME

Digital CCD camera images of the star LO Pegasi were obtained from 2011 May - July using a Meade 0.3-meter Schmidt-Cassegrain telescope in order to measure variations in the star's brightness due to the presence of large dark starspots rotating into and out of view of Earth. We used a technique known as Light-Curve Inversion to map the star's surface using these variations in brightness. Starspots, like sunspots, are regions of strong magnetic field on the star's surface, so that by studying starspots scientists can learn more about the physics of stellar magnetism.

STELLAR SURFACE IMAGING OF LO PEGASI VIA LIGHT CURVE INVERSION (LI)

Starspots are cool, dark regions on a star's surface, which like sunspots are associated with strong magnetic fields. Indirect methods must be used in order to study starspots because stars are seen as pinpoints of light even using the larges telescopes. Light-Curve Inversion (LI) is a constrained non-linear inversion algorithm designed to compute surface images of a star using variability of the star's brightness as the starspots are carried into and out of view by the star's rotation. LO Pegasi (HIP 106231) is a rapidly rotating young star similar to the Sun but with a rotational period of ~10.2 h, which is known through prior studies to exhibit large starspots. Images of LO Pegasi were obtained during a 10-week period from 2011 May – July using a CCD camera mounted on a 0.3-m. Schmidt-Cassegrain telescope at Perkins Observatory through standard B, V, R, and I photometric filters. The brightness variations were extracted from the images via differential aperture photometry, in which the brightness of LO Pegasi was compared to that of a star of constant brightness. We present the maps of the stellar surface we obtained by inverting the data for the brightness variations using the LI algorithm.

Board 30

C. CRAWFORD,
SCIENCE DEPARTMENT, DUBLIN JEROME HIGH SCHOOL

Faculty Mentor: Brad Trees
OWU Department of Physics and Astronomy

THE APPLICATION AND USE OF *WOLFRAM MATHEMATICA 8* FOR ELECTRONIC LEARNING ENVIRONMENTS

Technology has permeated society in ways that were unimaginable even ten years ago. With the increase in both capacity and capabilities, we are reaching times in which technology can truly enhance the learning environments by enabling the learners to stretch their mental capacities as they interact with the content. The intent is to marry symbolic computation software with standard content of a calculus-based introductory physics course into an electronic textbook. This permits the arrangements of animations and graphs in an interactive pictorial representation for the learner to master fundamental physics concepts, while also retaining the mathematical rigor that is expected in a traditional classroom. In conjunction with the framework of Bloom's Taxonomy and Howard Gardner's Theory of Multiple Intelligences, *Mathematica's* "Core Language" and the "Dynamic Interactivity" of the *manipulate* command allow construction of the learning environments suitable to an electronic text. In addition, *Mathematica* provides the delivery method of the learning experience with the "Notebook and Documents" feature that is embedded within the capabilities of the software. Furthermore, these electronic learning environments are aligned with the parameters that have been established by the *Partnership for 21st Century Skills* and the *Five Minds of the Future* by Howard Gardner. With the use of *Mathematica 8* software, the learners are now capable of interacting with the content in an electronic environment and at an elevated level, which allows them to synthesize information in ways that are more compelling than without the software.

MATTHEW HEFLIN,
UNIVERSITY OF PUGET SOUND

Faculty Mentor: Scott Linder
OWU Department of Mathematics and Computer Science

In many settings, researchers observe data that have been subjected to censoring. For example, in studying computer processors, 100 processors begin an experiment. The experiment ends after 20 processors have failed. In this case, 80 processor lifetimes have been "censored." Unfortunately, many of the standard statistical methods applied to uncensored data fail when applied to this scenario. Sampling distributions of statistics, which form the backbone of statistical methodology, are mathematically intractable, so approximations must be obtained in order to construct reasonable inferential methods that researchers can use.

INFERENCE FOR CORRELATION IN A BIVARIATE NORMAL MODEL SUBJECTED TO TYPE II CENSORING

Suppose a random sample of n bivariate normal variates is subjected to Type II censoring on one of the variates, so that only those associated with the p smallest order statistics and their concomitants are observed. We demonstrate that Fisher's Z transformation, widely used for inference about the correlation coefficient, performs poorly in this setting, especially when censoring is moderate or severe. We propose a modification to percentile estimates obtained using the Normal distribution suggested by the Fisher Z transformation. The modification is determined from experimental settings (degree of censoring), and is obtained using simulation and regression modeling. We demonstrate that use of modified percentile estimates results in improved inference for the population correlation coefficient.

MA'AYAN DAGAN,
OBERLIN COLLEGE

Faculty Mentor: Brad Trees
OWU Department of Physics and Astronomy

Josephson Junctions (JJs), microwave emitters, have a power output that can be maximized by arranging the junctions in an array and thus synchronizing their emissions. We study a basic array by using a model for current flow through JJs and derive equations for the behavior of the JJs over time. A stability analysis of the equations showed that once an array of JJs is synchronized, any disturbance to the system will eventually correct itself and bring the JJs back into sync.

ANALYTIC INSPECTION OF THE SYNCHRONIZATION OF A SINGLE-PLAQUETTE JOSEPHSON JUNCTION ARRAY*

We report on a study of the time-dependent behavior of a single-plaquette array of Josephson Junctions (JJs). JJs arranged in this manner have the notable quality of achieving Josephson phase synchronization. An analysis of this synchronization is motivated by the fact that the power output of synchronized JJs has been harnessed(1), with great potential for powering small (chip-scale) devices. The RCSJ model of JJ current flow was used in concert with a perturbation method to produce simplified differential equations for the dynamics of the Josephson phases. Several features of the system which are not fully explicable by numerical methods are well illuminated by the analytic treatment described. For instance, synchronization of JJs in the array was shown to be linearly stable – any small disturbance of the synchronization decays in time. Furthermore, a closed-form function was derived to describe the behavior of that decay in the limit of large coupling between the current-biased junctions in the plaquette. Large-coupling approximations also produced functions that accurately predict the time-dependent synchronization of a JJ pair. Of particular interest is the effect of the introduction of a magnetic field perpendicular to the array. Preliminary results show the field affects both the long-time behavior of JJ phase differences and the stability of synchronized states.

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1 F. Song, F. Müller, T. Scheller, A. Semenov, M. He, L. Fang, H. Hübers, and A. M. Klushin, *Appl. Phys. Lett.* **98**, 142506 (2011)

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So far, our knowledge of the atomic nucleus is somewhat limited since it is based primarily on studies of systems that lie within or near the "valley of stability," the set of stable isotopes that include those which can be found in nature. However, recent studies suggest that the structure of nuclei changes the farther they are from the valley of stability, including the way in which the constituent protons and neutrons arrange themselves. The focus of this research is to study an exotic isotope of beryllium (^{13}Be) that is so short-lived it can be detected only from the products of its disintegration. This summer, we began the research by calibrating a series of detectors that were used to track and record the breakup of ^{13}Be nuclei during an experiment conducted last fall at the National Superconducting Cyclotron Laboratory at Michigan State University. Our work will eventually allow for the unambiguous identification of the ^{13}Be disintegration products, which will be used to help determine the structure properties of ^{13}Be immediately prior to its decay.

SELECTIVE POPULATION AND DECAY OF NEUTRON UNBOUND STATES IN ^{13}BE

Atomic nuclei with an overabundance of neutrons relative to the number of protons are known to exhibit different structural properties than their more stable counterparts. For example, the "shells" in which the neutrons arrange themselves are known to change far from stability, resulting from a relative shifting of the discrete energy states that are available to the valence particles. The exotic neutron-rich nucleus ^{13}Be provides an excellent opportunity to explore the effects of neutron excess on shell behavior since it has one more neutron than an established closed shell at neutron number N = 8. The ultimate goal of this research is to understand the decay process by which ^{13}Be disintegrates into a neutron and a ^{12}Be nucleus, to identify and measure the energy states of ^{13}Be and infer the energy levels occupied by its valence neutrons, and to compare the measured results to contemporary shell model calculations. In November, 2010, an experiment was conducted at the National Superconducting Cyclotron Lab at Michigan State University that produced ^{13}Be and recorded events associated with its disintegration. The work accomplished this summer has focused on calibrations of the various detector systems used to record and track the ^{12}Be nuclei that result from the decay of ^{13}Be. These included position and energy-sensitive calibrations that are necessary to track the trajectories and measure the energies of the ^{12}Be nuclei. Such calibrations are essential to the proper identification of ^{12}Be, which eventually will lead to inferences about the structure of ^{13}Be just prior to its dissociation.

Graduation with Departmental Honors requires an independent project, an oral exam on the project, and a comprehensive exam in the student's major department during his or her senior year. The program is open to students who have attained cumulative grade point averages of 3.5 in their majors after fall semester of the junior year, as well as overall grade point averages of 3.0 or the support of their academic major departments, and have successfully petitioned the Ohio Wesleyan Academic Policy Committee.

Student Name	Department	Supervising Professor	Title
Greer Aeschbury	Latin American Studies	Jeremy Baskes	Indigenous Feminism? The Formation of Indigenous Women's Identity in Bolivia
Lindsey Aurora	Zoology	David Markwardt	Nonsense Mediated Decay (NMD) and Gene Expression
Rachel Bowes	Zoology	Shala Hankison	Repeatability and Consistency in the Three Spined Stickleback
Christa Cocumelli	Physical Education	Chris Fink	Sport Nutrition in Collegiate Women's Field Hockey: a Qualitative Inquiry
Yan Dong	Psychology	Dick Leavy	Conceptualizations of stress among Chinese students using Mandarin and English
Bridget Fahey	Politics/Government	Craig Ramsay	Public Opinion, Demographics and Environmental Government Action / Policy
Emma Hilliard	Humanities/Classics	Don Lateiner	Painted Red: Caesar, Religion, and Deification
Alex Howe	Physics	Robert Haring-Kaye	Nuclear Structure of ^{71}Se
Kristen Lear	Zoology	Jed Burtt	Species Preferences in Bat House Design: Implications for Conservation and Ecosystem Services
Meredith Palmer	Zoology	Shala Hankison	Paternal Care in Stickleback Fish
Stacy Snow	English	Marty Hipsky	Suburban Discontent: A Look at Contemporary Film and Literature
Aryn Taylor	Economics	Bob Gitter	Unemployment and Real Property Tax Delinquency in Ohio
Patricia Troy	Zoology	Amy Downing	Effects of Long-Term Exposure to Pesticides on Aquatic Communities
Sarah Truchan	Physical Education	Nancy Knop	A Rationale and Strategy for Injury Correction and Prevention of the Overhand Throwing Motion in College Softball Athletes
Sean Williams	Zoology	Jed Burtt	Glare as a Selection Pressure on Bill Color in Temperate and Neotropical Birds
Christina Yost	Religion	Emmanuel Twesigye	Gender Differences that Lead to Burnout Among Ministers

PAST SSRP PARTICIPANTS

EVAN BAI, OWU '11

Presented Research: American Society of Plant Biologists National conference

Currently: Beginning Ph.D. graduate work in the Biological and Biomedical Sciences Program, Yale University

MEREDITH PALMER, OWU '11

Currently: Studying the behavioral ecology of striped mice in South Africa

SHARIF KRONEMER, OWU '12

Currently: Spent summer 2011 in China to research the water crisis they are experiencing, will teach a seminar course (Psychology 499) at OWU on consciousness

JACK SCHEMENAUER, OWU '11

Currently: Moved to Chicago to be involved in local food cart scene and activism through starting his own food cart, Flappin' Jack's Flapjack Shack, a vegan pancake/breakfast food cart

KELLIE GROSS, OWU '12

Currently: Spent summer 2011 at the Mayo Clinic in Rochester, MN, doing research on neuroregeneration after spinal cord injury

LINDSEY AURORA, OWU '11

Currently: Beginning medical school at Wayne State University

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Presented Research: American Society for Microbiology Meeting in New Orleans, May 2011

Currently: Working at Neogen in East Lansing, MI, will begin medical school in Fall 2012 at Michigan State University

NASIE CONSTANTINO, OWU '12

Presented Research: Ohio Branch of the American Society for Microbiology meeting in Athens, OH, April 2011

Currently: Spent summer 2011 at Penn State Harrisburg doing research in biofuels

HENGZHI CHEN, OWU '12

Currently: Spent summer 2011 in China interning in a design company of electricity

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Currently: Doing volunteer work in China, applying for graduate school programs in the United States for 2012

RACHEL BOWES, OWU '11

Currently: Beginning a Ph.D. program in the Department of Ecology and Evolutionary Biology at the University of Kansas

JARROD UHRIG, OWU '11

Currently: Beginning medical school at Ohio University College of Osteopathic Medicine

CAMPUS AND OFF-CAMPUS RESEARCHERS

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